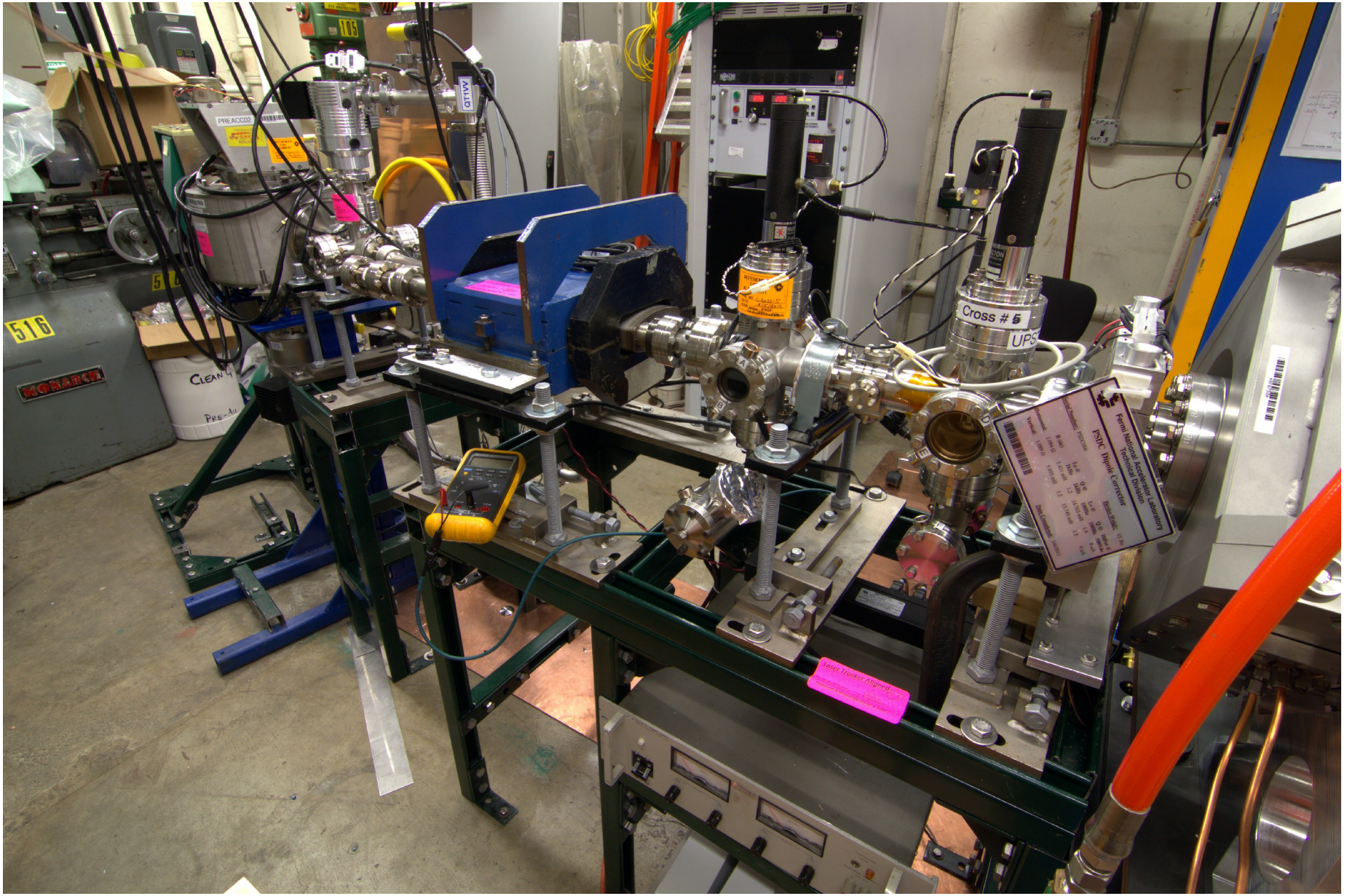
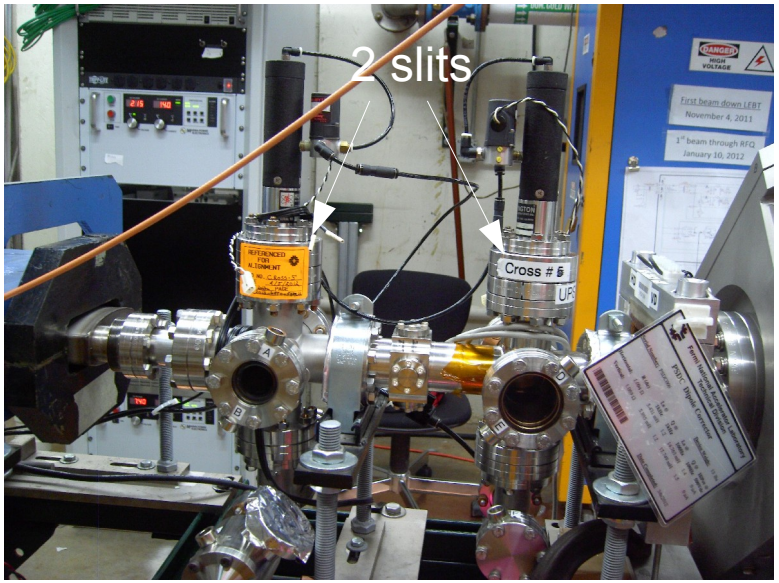
Spectrometer Measurement

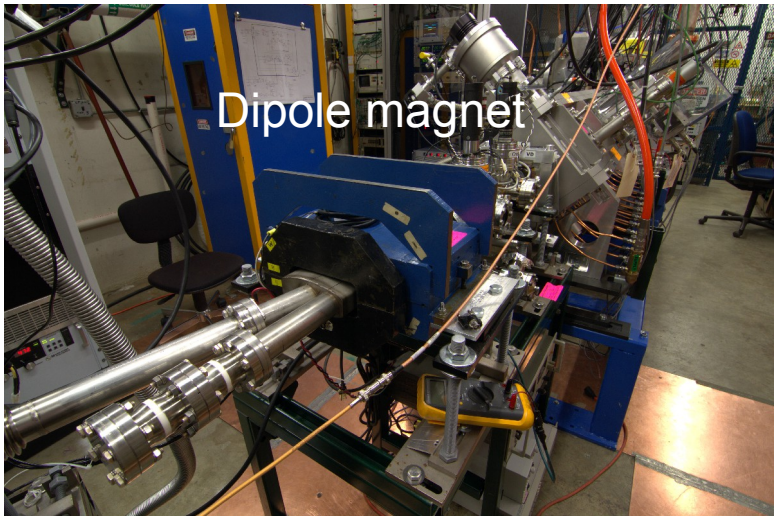
C.Y. Tan, P. Karns, D. Bollinger
13 Apr 2012

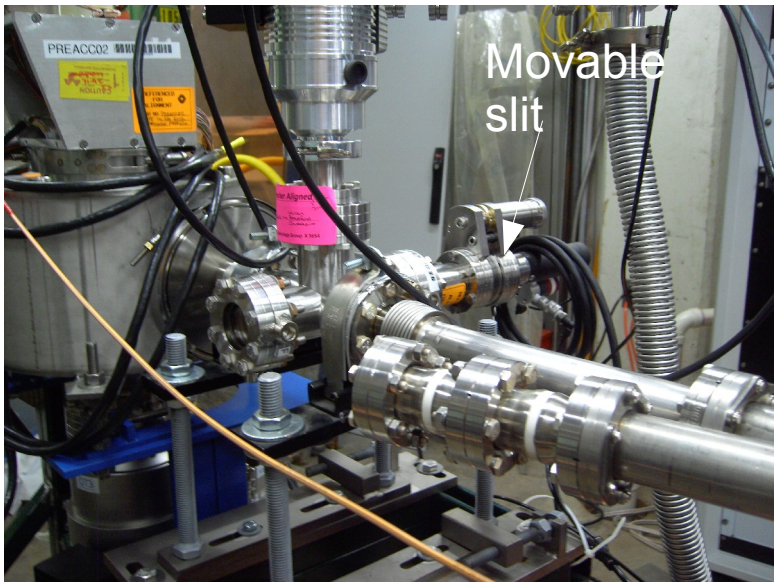
The Spectrometer

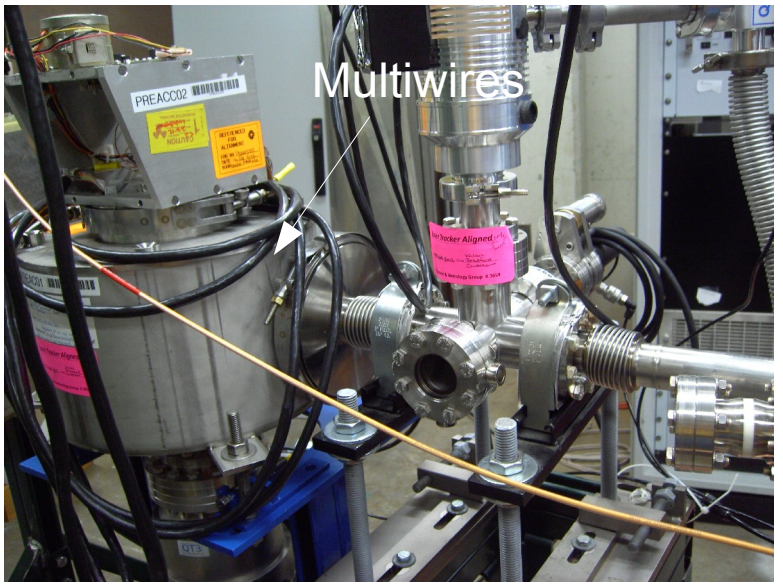


Views of the Spectrometer



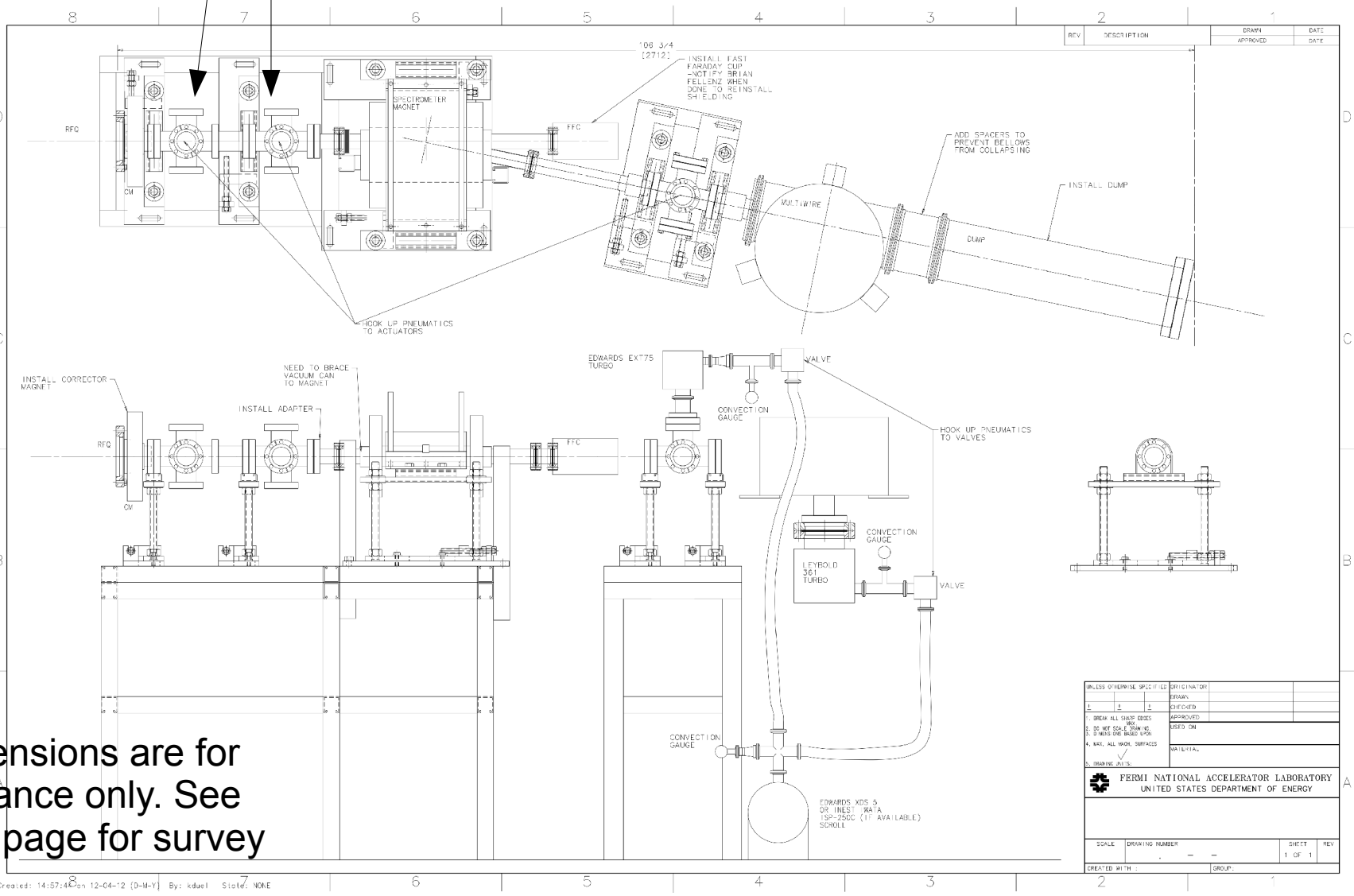






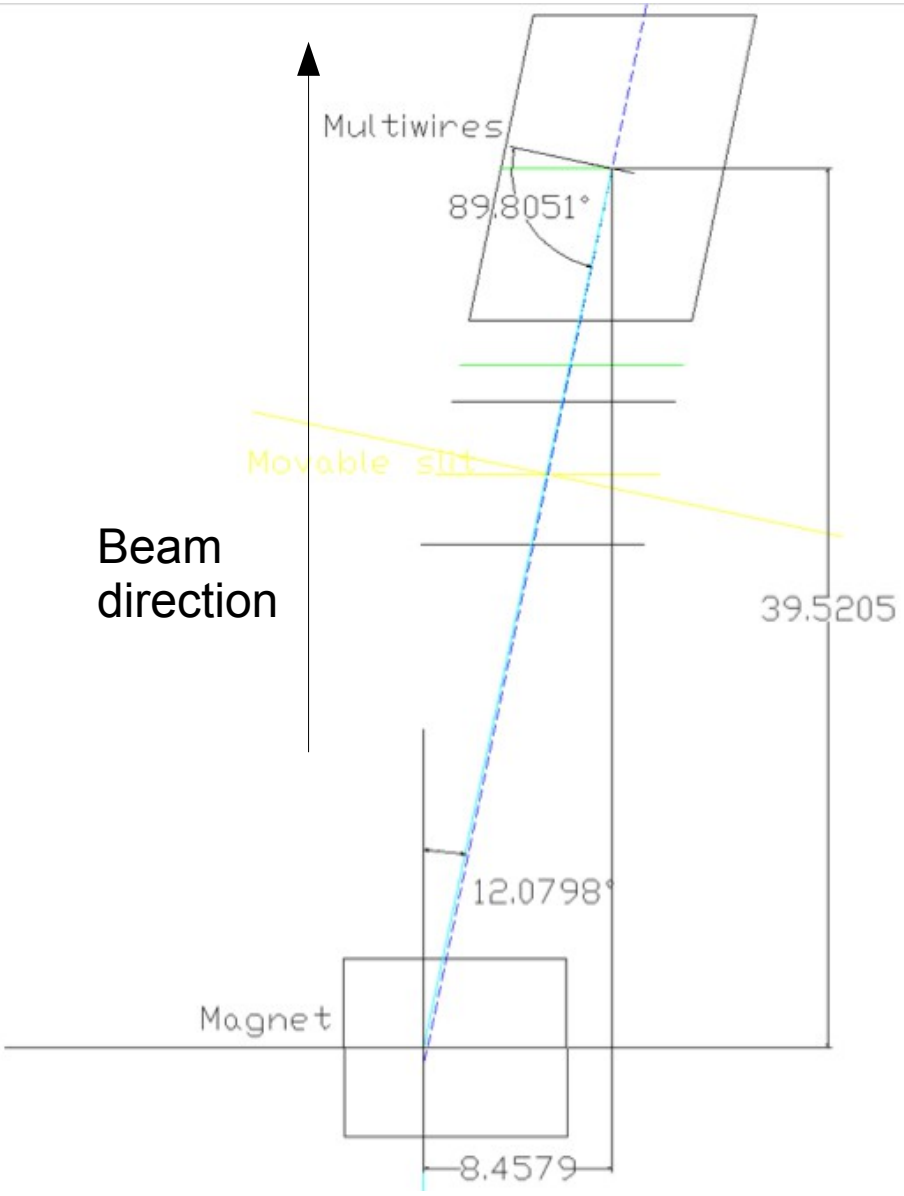
Overview of spectrometer layout

The double slit defines the longitudinal axis of the beam



Dimensions are for guidance only. See next page for survey data

Spectrometer Survey Data

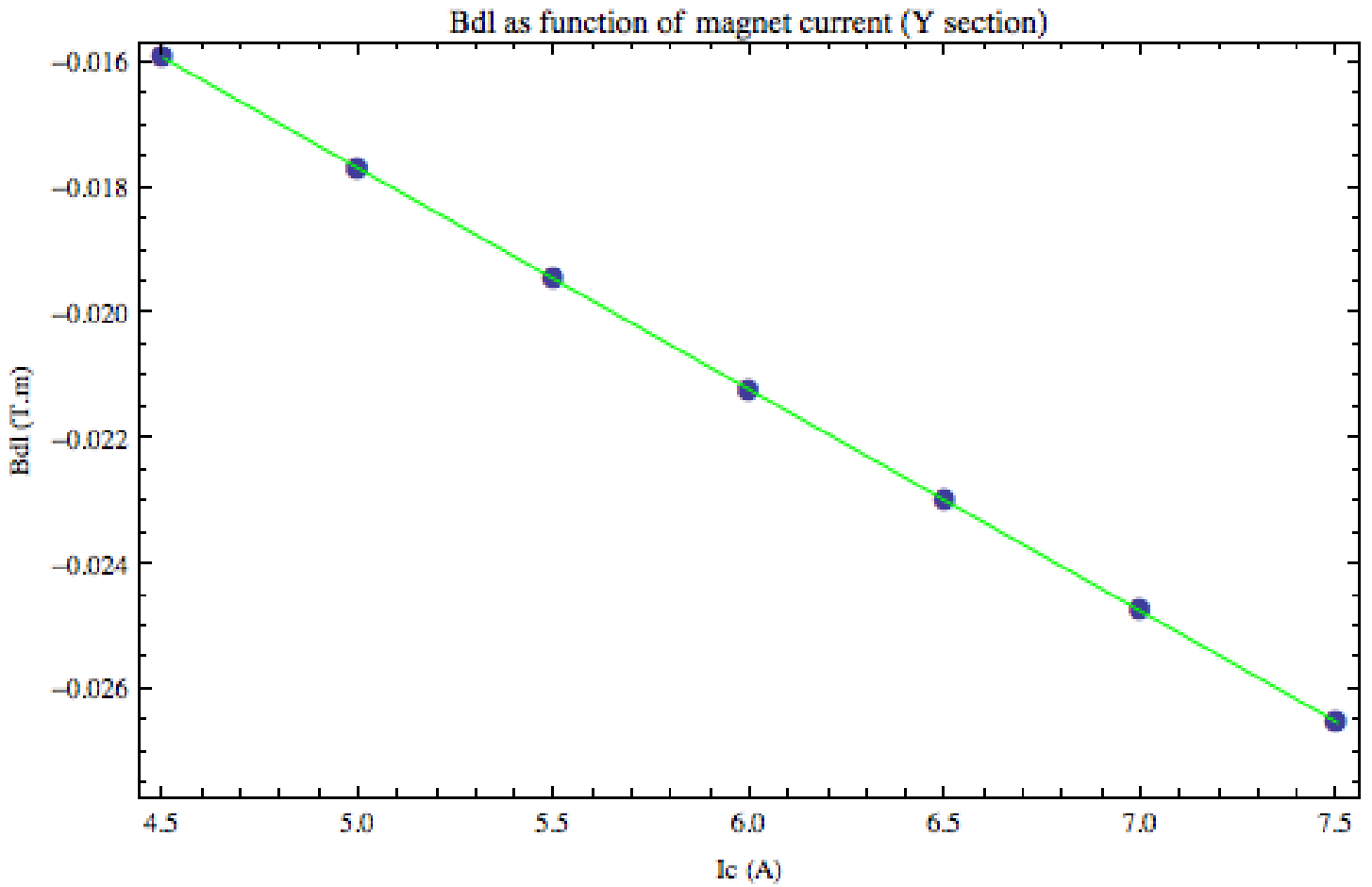


A little too many decimal places here … Survey measurements is to ±0.001 inches.

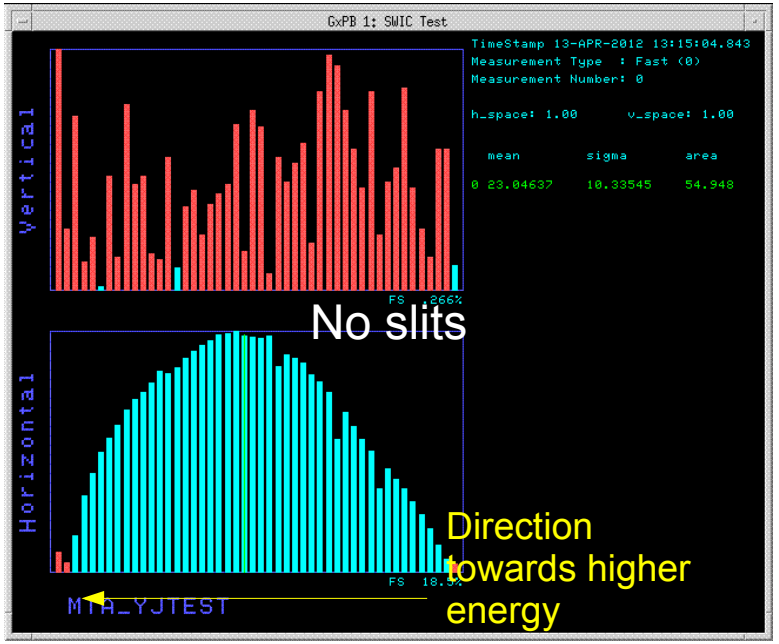
Spectrometer and Experimental Parameters

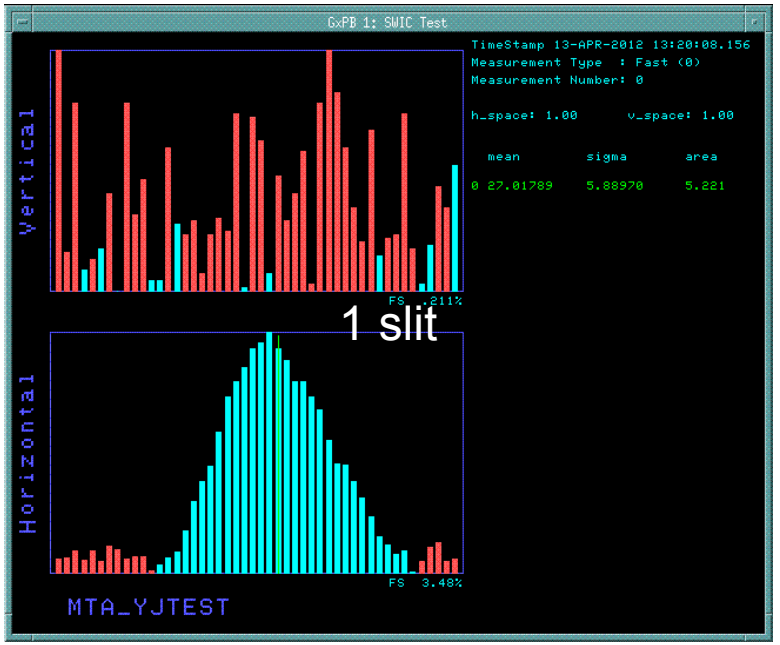
- 2 slits (0.8 mm each) downstream of RFQ.
- Dipole magnet bend is 12.08 deg.
- Multiwire resolution is 1 mm and range is +/- 24 mm.
- Power of RFQ is 138 kW, 168 kW, 180 kW (1st pass), 196 kW.

Bdl as a function of current



Beam on wires with dipole ON

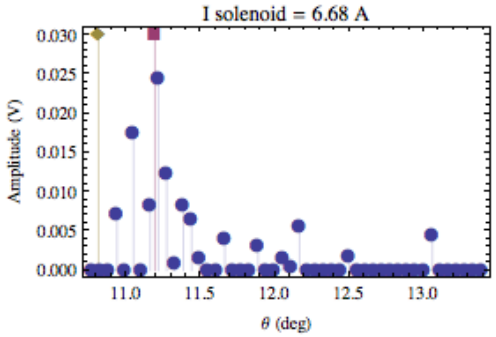


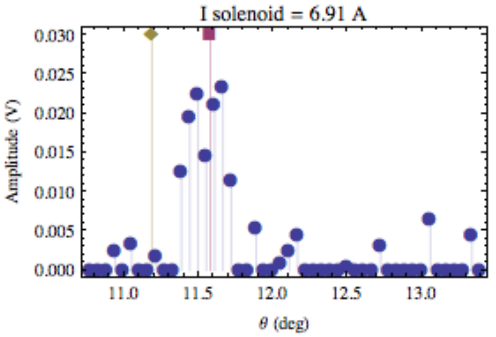


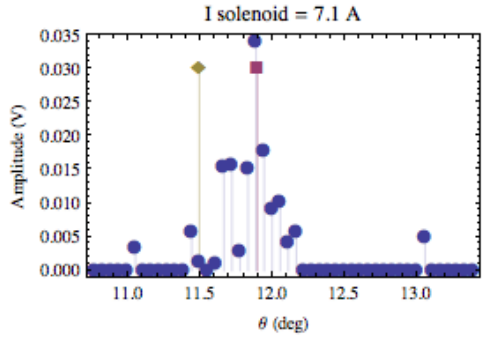
Note upper window in each plot is not relevant in this experiment.

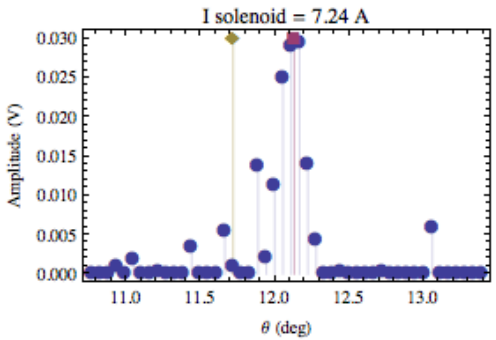
Blue data is beam, red is data that is opposite in sign to blue. The red data will be stripped for further analysis. See next slide.

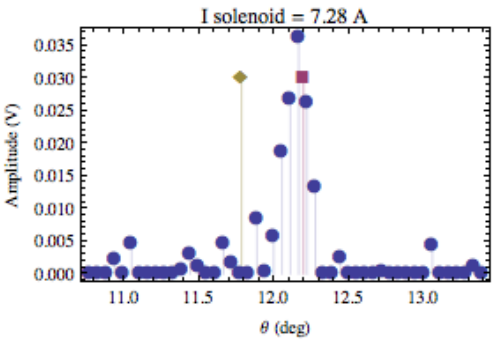
BEFORE charging cap change

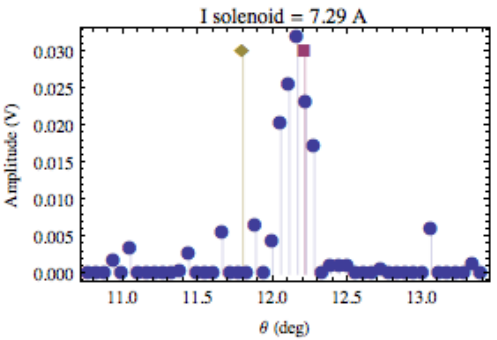


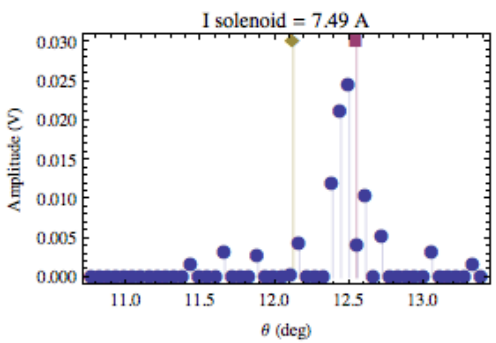


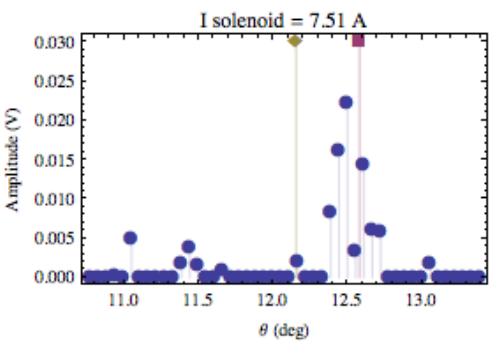


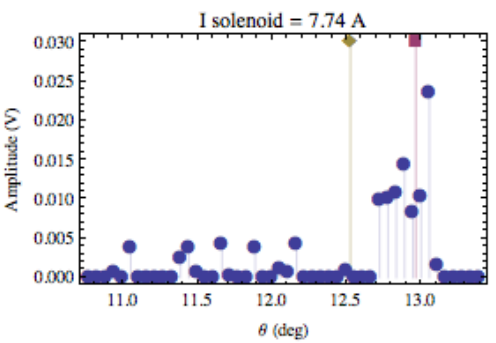


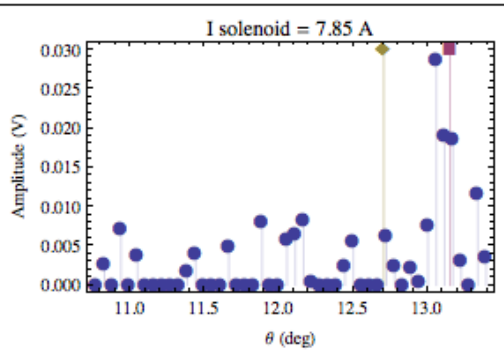






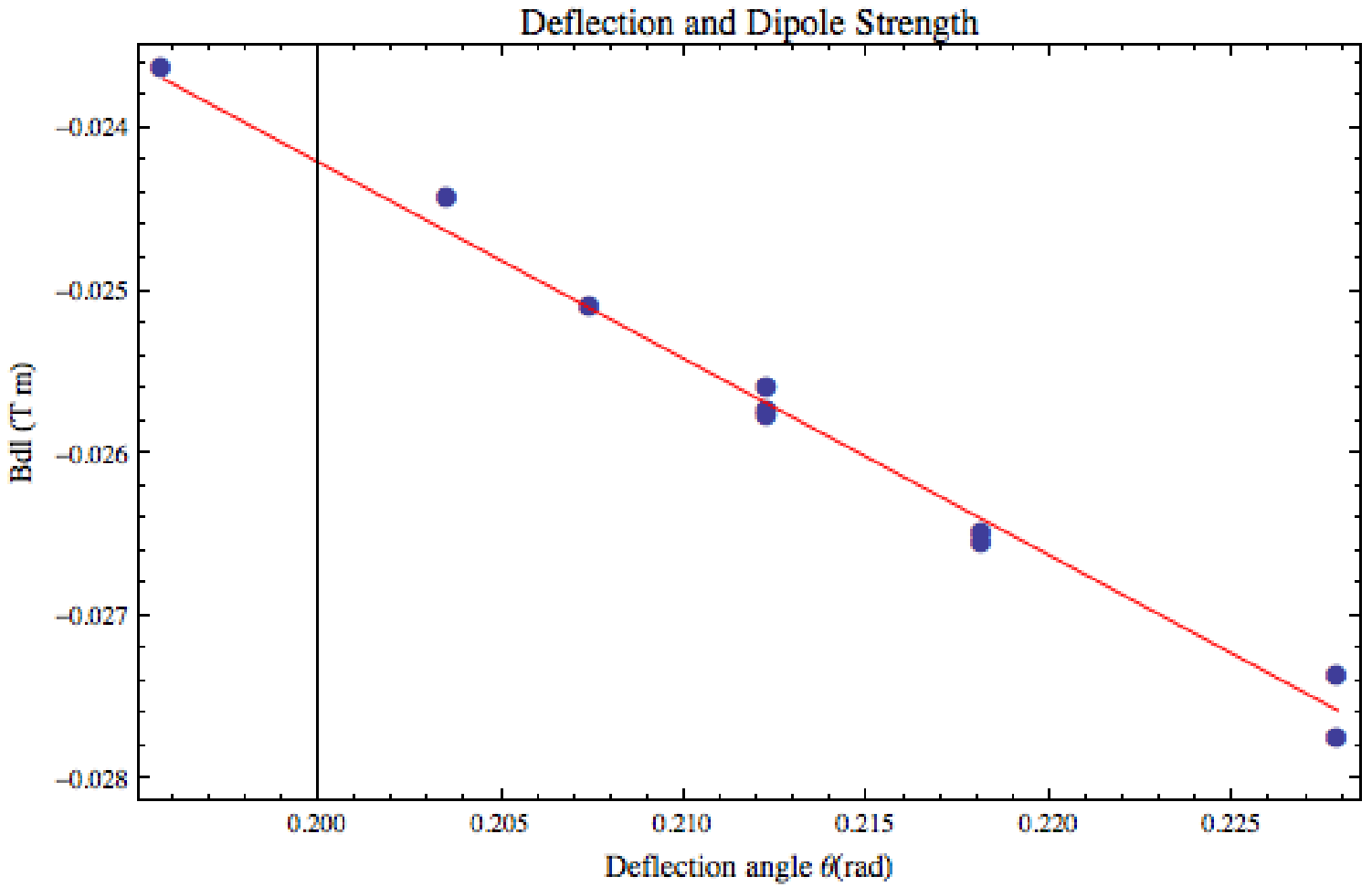






Previous data after red data is stripped. Each picture is the particle distribution when solenoid current is changed.
The red square is where 700 keV H- should theoretically be deflected. The green diamond is for 750 keV.

Tracking peak of distribution only

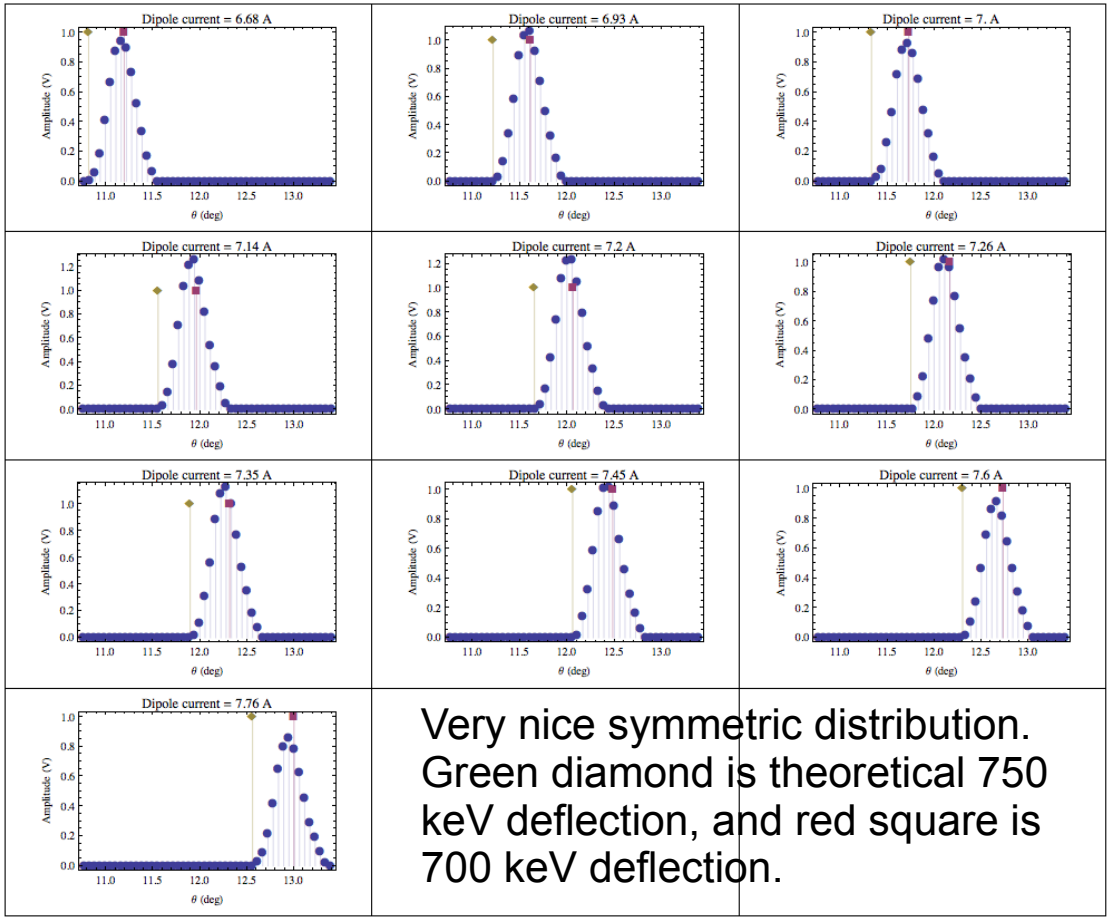


Slope is $B\rho = p/c$ = (0.1211±0.0002) T.m/rad (statistical error only). Solving for kinetic energy gives (701± 2) keV (statistical error only)

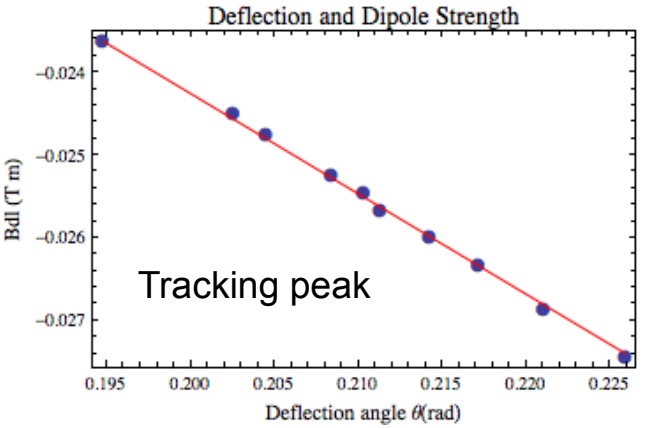
Spectrometer Measurements II

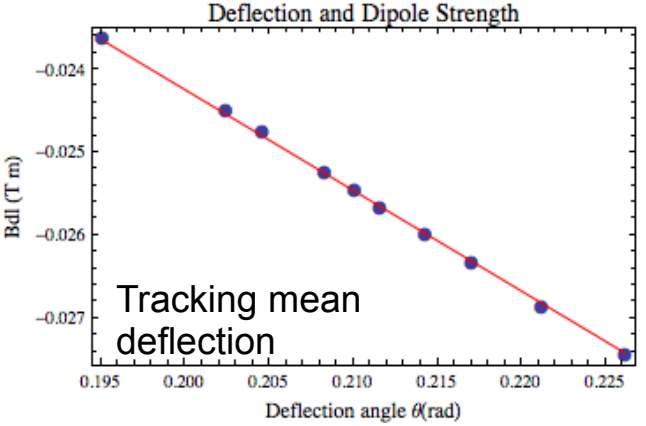
- Increase sensitivity of multiwires with capacitor change.
- Measure energy and bunching as a function of RFQ power.

168 kW RFQ power (forward)
12 kW (reflected)



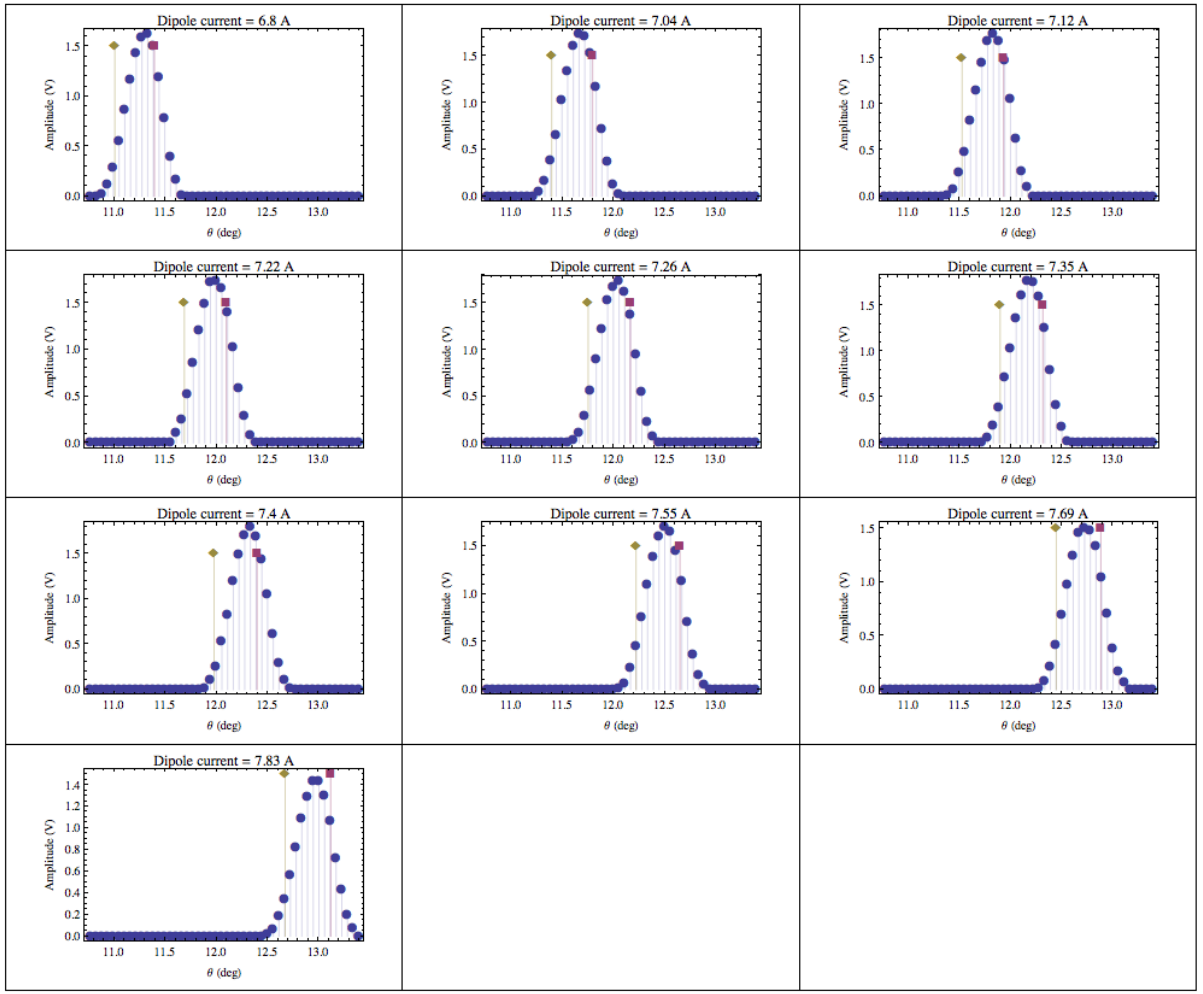
Very nice symmetric distribution. Green diamond is theoretical 750 keV deflection, and red square is 700 keV deflection.

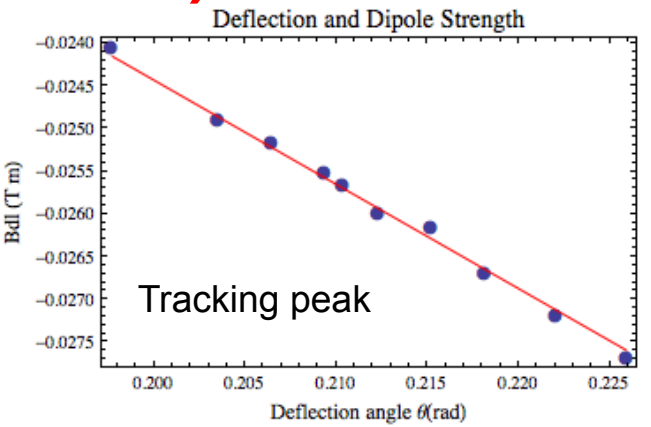


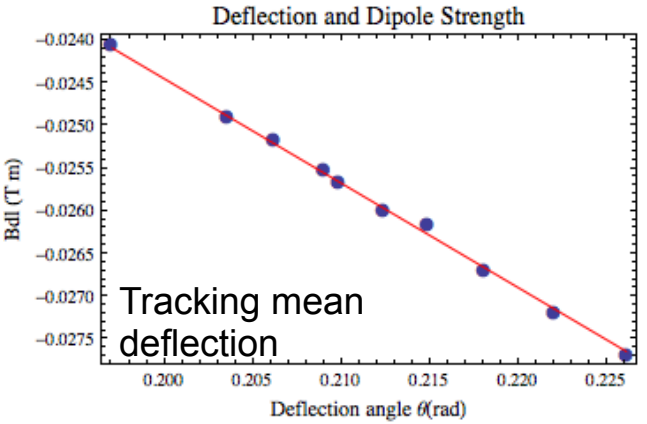


Energy from peak tracking = 704±1 keV
Energy from mean deflection tracking = 703.3±0.6 keV

196 kW RF power (forward)
17 kW (reflected)

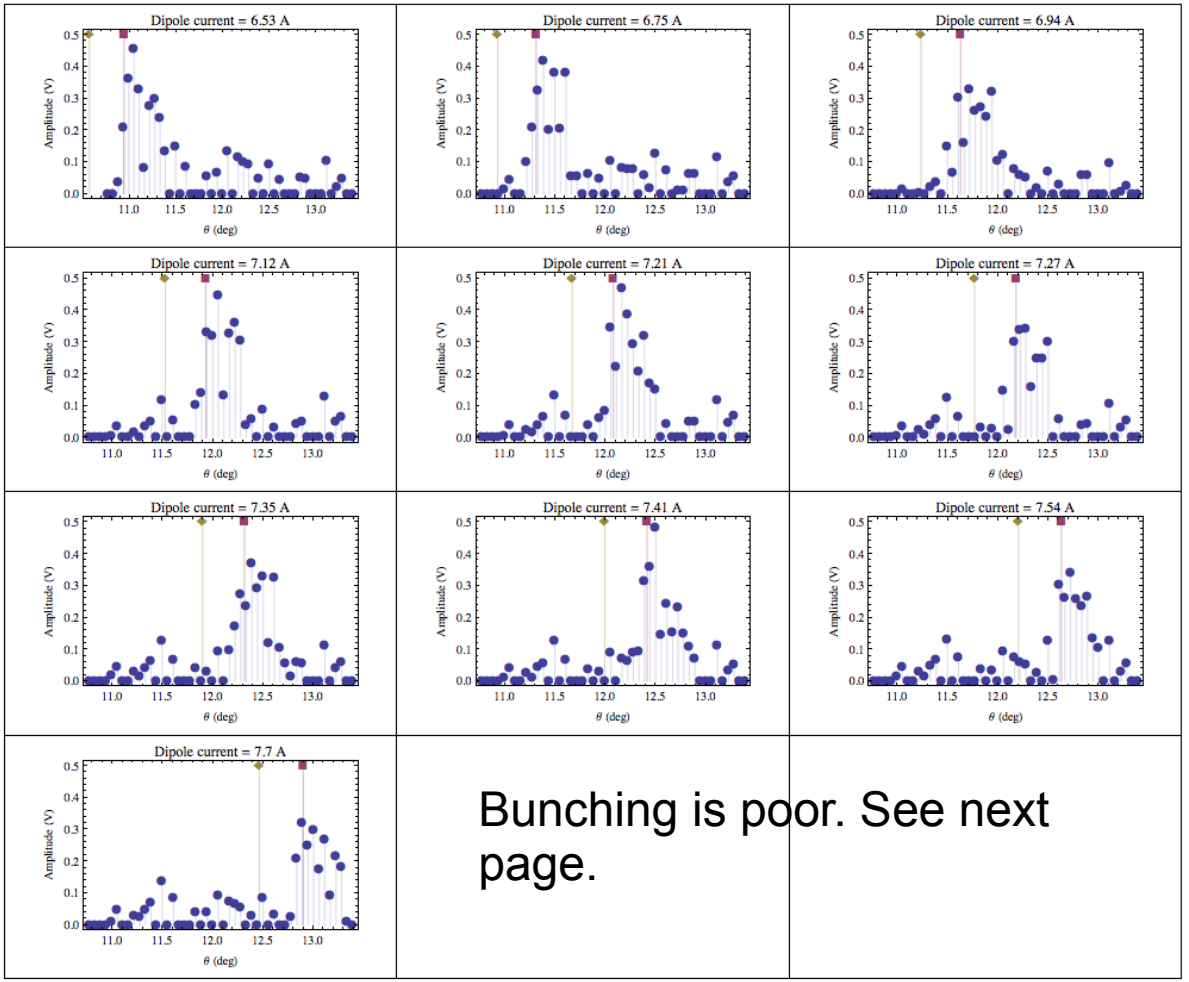




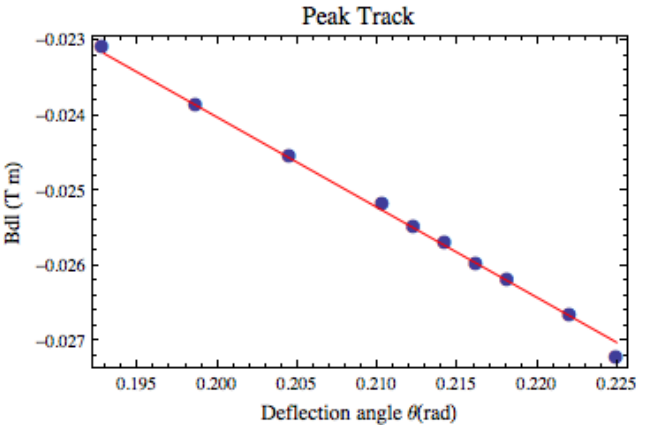


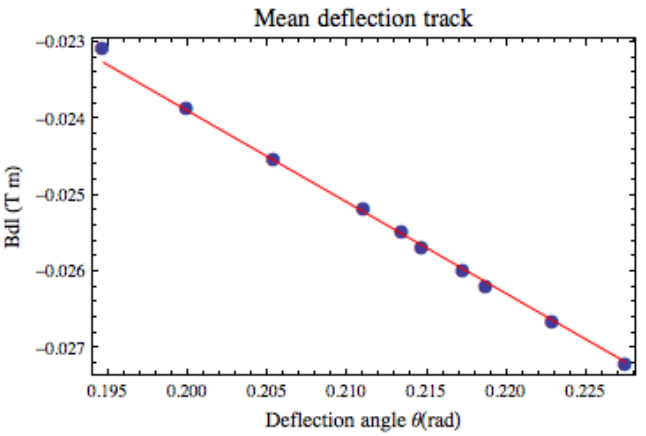
Energy from peak tracking = 714±1 keV
Energy from mean deflection tracking = 715±1 keV

138 kW RF power (forward)
7 kW (reflected)



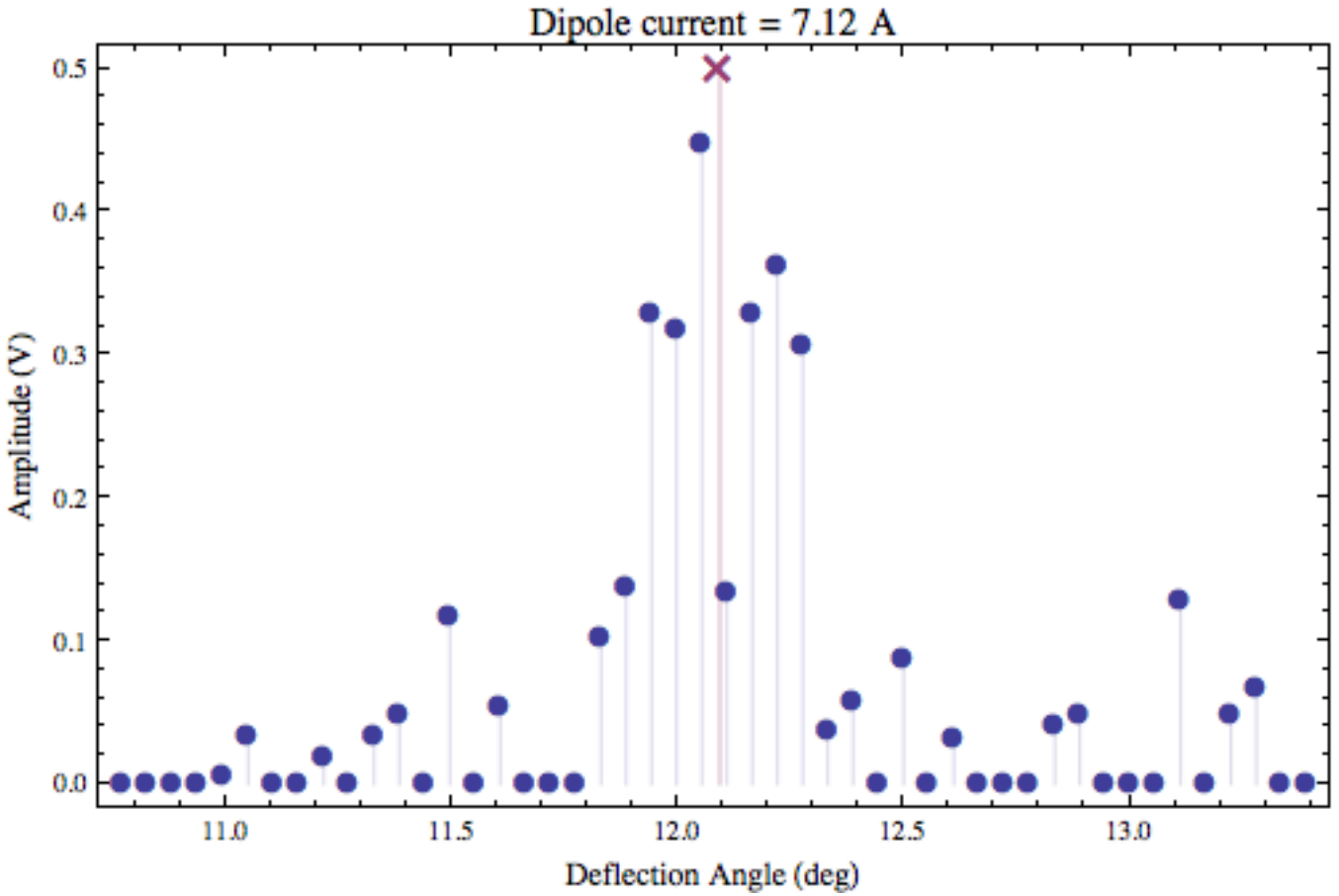
Bunching is poor. See next page.





Energy from peak tracking = 691±1 keV
Energy from mean deflection tracking = 683±1 keV

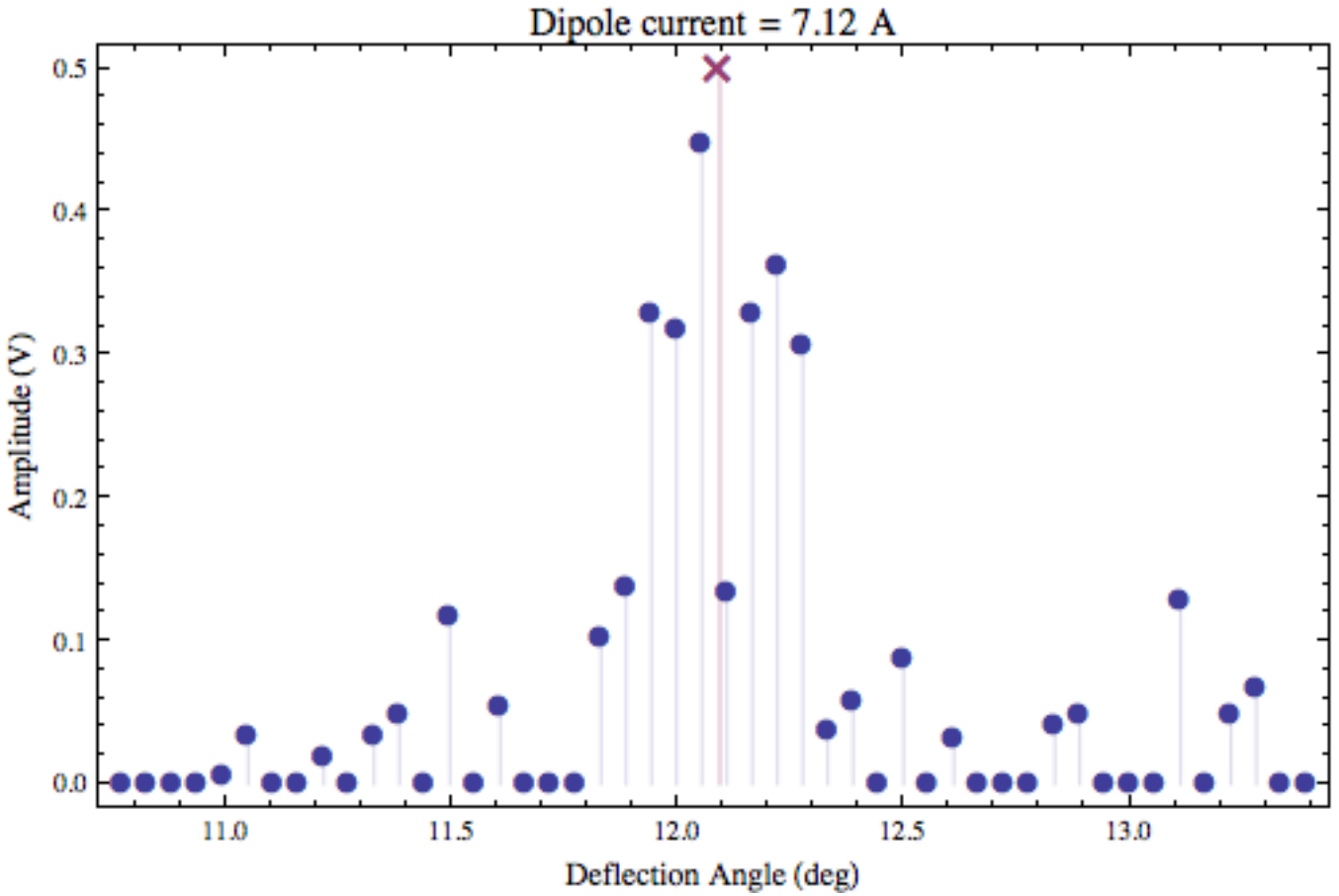
Double Hump Structure for 138 kW?



“x” is the mean deflection angle. Seems that there are two humps in the data.

At 138 kW, there's factor of 3 less voltage on the multiwires.

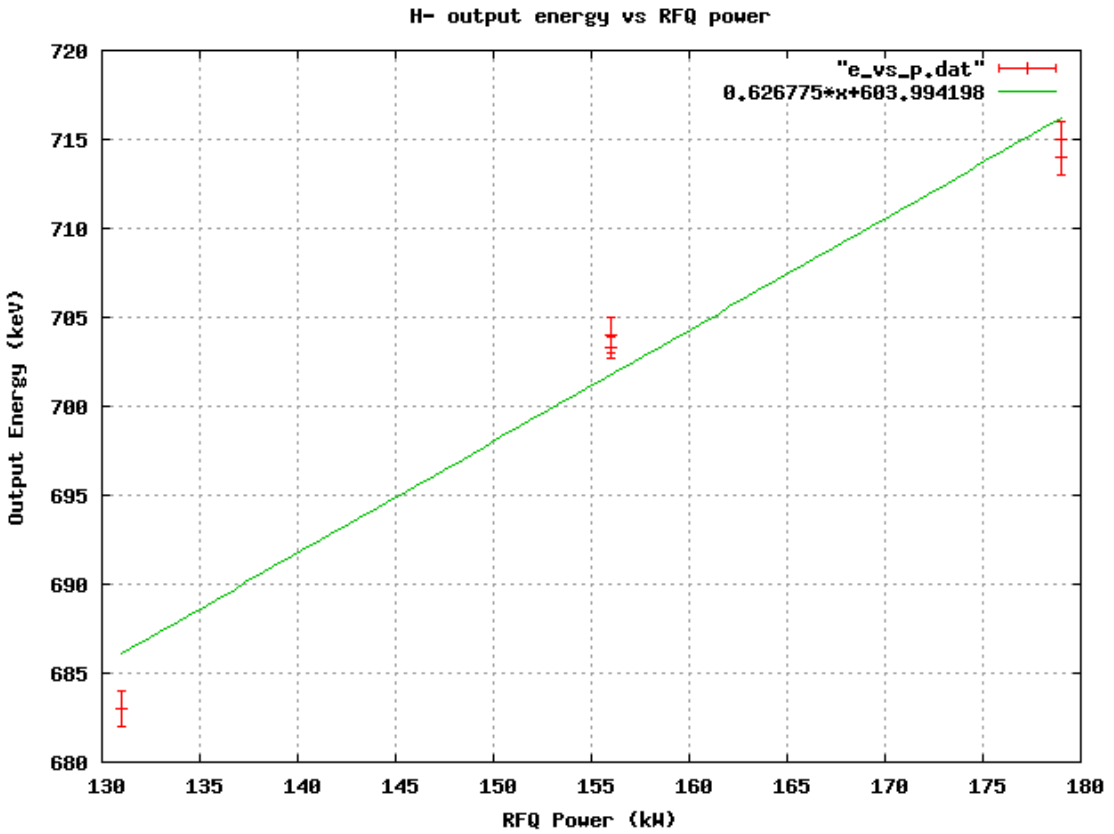
Double Hump Structure for 138 kW?



“x” is the mean deflection angle. Seems that there are two humps in the data.

At 138 kW, there's factor of 3 less voltage on the multiwires.

Fit RFQ Power to Output Energy

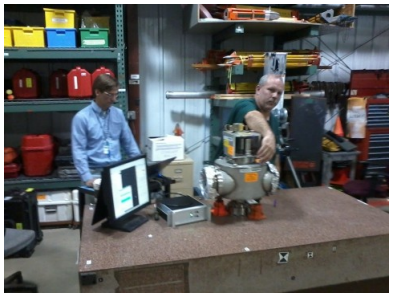
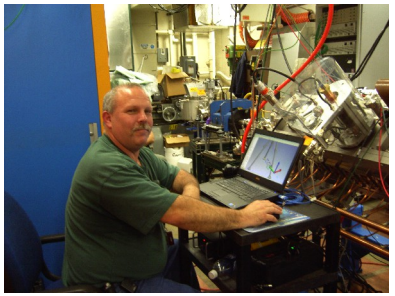
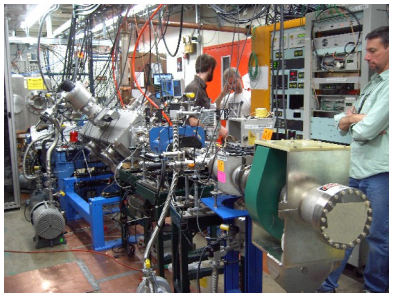


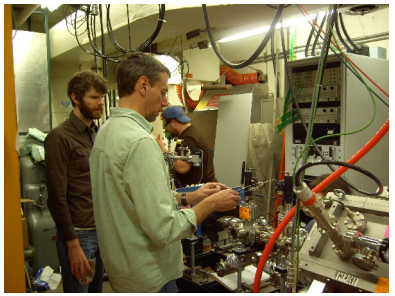
Fit is rather bogus because off DC offset is not 35 keV. This indicates a non-linear fit is required.

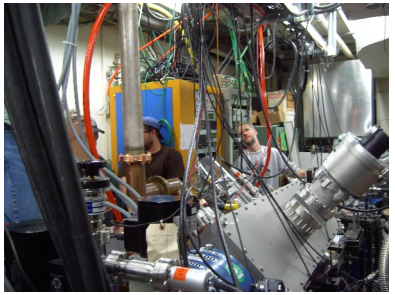
Conclusion

- KE of H- is between 683 to 715 keV depending on RFQ power
  - Systematic error dominated by Bdl which is ~1%.
  - Basically same as TOF measurement ~700 keV.
- Energy distribution shows that bunching only occurs above ~140 keV.
- There are no particles at 750 keV at 168 kW and small number at 196 kW.

Thanks to everyone who helped make this measurement happen!





- K. Duel, B. Ogert, J. Briney, J. Kubinski (Mech. Support)
- D. Bollinger, P. Karns, B. Schupbach, K. Koch, A. Feld (Preacc group)
- R. Tomlin, K. Triplett, J. Larson (Proton source)
- B. Oshinowo, C. Wilson, G. Coppola, G. Teafoe and entire survey group.
- G. Velev, J. DiMarco (Technical Division)
- G. Tassotto, D. Schoo, B. Fellenz and others In instrumentation group.
- M. Church, E. Harms and A0 group for lending us slits, and misc. vacuum parts.
- B. Hanna and V. Scarpine for measurement discussions.
- **B. Pellico who signed all the reqs!**
- **And anyone whom I inadvertently left out. Thanks!**